

<110> Organization Name : Carlsberg A/S

Application Project

<120> Title : Barley for production of flavor-stable beer
<130> AppFileReference : 1
<140> CurrentAppNumber :
<141> CurrentFilingDate : ____-____-

Sequence

<213> OrganismName : Hordeum vulgare cv. Barke
<400> PreSequenceString :
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gccgtcgacc aaggtaatca ctaccctact cccgccttct cctctgttta caagatata 240
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ctcctccgac gagctgtacc tcgggcagcg ggacacgccc gagtggacact cggacccaaa	3960
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gggcattgaac catgaccacgg agctcaagaa ccgcaacggc ccggctaagt ttccctacat	4080
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<212> Type : DNA

<211> Length : 4165

SequenceName : SEQ ID NO: 1

SequenceDescription : Barley genomic sequence of cv. Barke,
spanning

the start and stop codons of the gene encoding LOX-1

Sequence

<213> OrganismName : Hordeum vulgare mutant D112

<400> PreSequenceString :

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atcgacggca tcggcgagtt cctcggcaag ggctcacct gccagcttat cagctccacc	180
gccgtcgacc aaggtaatca ctaccctcct ccggcccttct cctctgttta caagatata	240
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acggcacgtc aaaagcaaca caaacctaaa ctaaagcaca aagacgtaa agcaagcaca	540
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 gggcatgaac catgacccgg agctcaagaa ccgcaacggc ccggctaagt ttccctacat 4080
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 catccccaaac agcatctcca tctaa 4165

<212> Type : DNA

<211> Length : 4165

SequenceName : SEQ ID NO: 2

SequenceDescription : Barley genomic sequence of mutant D112 spanning the segment, corresponding to the region between the start and stop codons of the gene encoding LOX-1 of cv. Barke

Sequence

<213> OrganismName : Hordeum vulgare cv. Barke

<400> PreSequenceString :

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 AVDQDNGGRG KVGAEAELEQ WVTSLPSLTT GESKFGLTDF WEVEKLGVPG AIVVNNYHSS 120
 EFLLKTITLH DVPGRSGNLT FVANSWIYPA ANYRYSRVFF ANDTYLPSQM PAALKPYRDD 180
 ELRNLRGDDQ QGPYQEHDRI YRYDVYNDLG EGRPILGGNS DHPYPRRGRT ERKPNASDPS 240
 LESRLSLLEQ IYVPRDEKFG HLKTSDLFLGY SIKAITQGIL PAVRTYDFTT PGEFDSFQDI 300
 INLYEGGIKL PKVAALEELR KQFPLQLIKD LLPVGGDSLL KLPVPHIIQE NKQAWRTDEE 360
 FAREVLAGVN PVMITRLTEF PPKSSLDP SK FGDHTSTITA EHIEKNLEGL TVQQALESNR 420
 LYILDHHDRF MPFLIDVNLL PGNFIYATRT LFFLRGDGRL TPLAIELSEP IIQGGLTTAK 480
 SKVYTPVPSG SVEGVWELA KAYVAVNDSG WHQLVSHWLN THAVMEPFVI STNRHLSVTH 540
 PVHKLLSPHY RDTMTINALA RQTLINAGGI FEMTVFPGKF ALGMSAVVYK DWKFTEQGLP 600
 DDLIKRGMAV EDPSSPYKVR LLVSDYPYAA DGLAIWHAIE QYVSEYLAII YPNDGVLQGD 660
 TEVQAWWKET REVGHGDLKD APWWPKMQSV PELAKACTTI IWIGSALHAA VNFGQYPYAG 720
 FLPNRPTVSR RRMPEPGTEE YAELERDPER AFIHTITSQI QTIIGVSLLE VLSKHSSDEL 780
 YLGQRDTPEW TSDPKALEVF KRFSDRLVEI ESKVVGMNHD PELKNRNGPA KFPYMLLYPN 840
 TSDHKGAAAG LTAKGIPNSI SI 862

<212> Type : PRT

<211> Length : 862

SequenceName : SEQ ID NO: 3

SequenceDescription : Protein sequence of full-length LOX-1 protein of cv. Barke

Sequence

<213> OrganismName : Hordeum vulgare mutant D112

<400> PreSequenceString :

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EFLLKTITLH DVPGRSGNLT FVANSWIYPA ANYRYSRVFF ANDTYLPSQM PAALKPYRDD	180
ELRNLRGDDQ QGPYQEHDRY YRYDVYNDLG EGRPILGGNS DHPYPRRGRT ERKPNASDPS	240
LESRLSLLEQ IYVPRDEKFG HLKTSDFLGY SIKAITQGIL PAVRTYVDTT PGEFDSFQDI	300
INLYEGGIKL PKVAALEELR KQFPLQLIKD LLPVGGDSLL KLPVPHIIQE NKQAWRTDEE	360
FAREVLAGVN PVMITRLTEF PPKSSLDP SK FGDHTSTITA EHIEKNLEGL TVQQALESNR	420
LYILDHHDRF MPFLIDVNLL PGNFIYATRT LFFLRGDGRL TPLAIELSEP IIQGGLTTAK	480
SKVYTPVPSG SVEGWVWELA KAYVAVNDSG WHQLVSHWLN THAVMEPFVI STNRHLSVTH	540
PVHKLLSPHY RDTMTINALA RQTLINAGGI FEMTVFPKGK ALGMSAVVYK DWKFTEQGLP	600
DDLIKRGMAV EDPSSPYKVR LLVSDYPYAA DGLAIWHAIE QYVSEYLAIY YPNDGVLQGD	660
TEVQA	665

<212> Type : PRT

<211> Length : 665

SequenceName : SEQ ID NO: 4

SequenceDescription : Protein sequence of inactive,
truncated LOX-1 of mutant D112

Sequence

<213> OrganismName : Hordeum vulgare cv. Neruda

<400> PreSequenceString :

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atcgacggca tcggcgagtt cctcggcaag ggcgtcacct gccagcttat cagctccacc	180
gccgtcgacc aaggtaatca ctaccctcct ccggccttct cctctgttta caagatata	240
tatttcttgc gtgtggccg gcccgcattgg atggatggat gtgtctggat cggctaaaga	300
agataggata gctagccctg gcccgtcgat tttacctgag catgggcata tgccatcgaa	360
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tcgagacaaa gcaacacaac aagcaaggac gacacgtcaa aagcaacaca acaagcaagg	480
acggcacgtc aaaagcaaca caaacctaaa ctaaagcaca aagacgtaaag agcaagcaca	540
caatcagcag gctataaaaca gttgtcatca aaaacaacgc tggaaagagag agagaaggaa	600
ggaagttagta gccatgaaaa attaaatcac cgggcgttgc tctttgcca acaattaatc	660
aagcaggata cgtggcatgt atagttcttg taagtaaact aagcatgtga tatgagaagg	720

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tgtatggtgt	ccatggtgag	aaagtgcaga	tcttgatttgc	cgttgggtcg	catgcacgca	2400
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ccacaccaggc	accatcacgg	cgagcacat	agagaagaac	ctcgaggggcc	tcacggtgca	2520
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tgtagataat	ttggcttcgt	tgcaattaat	ttgatgctgg	ccgatcaagt	gatcttatttgc	2640
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gacccttttc	tccctgcccgc	gcccacggcag	gctcacggcc	ctcgccatcg	agctgagcga	2820
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 cgctcatcaa cgccggcggc atcttcgaga tgacggtgtt cccgggcaag ttgcgttgg 3240
 gnatgtcggc cgtggtgtac aaggactgga agttcaccga gcaggactg ccggacgatc 3300
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 ctcactgaca ggaacgtggt aaaaaaaatg caggggcatg gcgggtggagg acccgtcgag 3420
 cccgtacaag gtgcggttgc tgggtcgga ctaccgtac gcggcggacg ggctggcgat 3480
 ctggcacgcc attgagcagt acgtgagcga gtacctggcc atctactacc cgaacgacgg 3540
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 gcccggcactc gaggagtacg cggagctgga gcgcgaccccg gagcgggcct tcattcacac 3840
 catcacgagc cagatccaga ccatcatcg cgtgtcgctg ctggaggtgc tgcgaagca 3900
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 ggcctggag gtgtcaagc gggtcagcga cccgctggtg gagatcgaga gcaaggtgg 4020
 gggcatgaac catgacccgg agctcaagaa ccgcaacggc cccgctaagt ttccctacat 4080
 gctgctctac cccaaacacct ccgaccacaa gggcgccgct gccgggctta ccgccaagg 4140
 catccccaaac agcatctcca tctaa 4165

<212> Type : DNA

<211> Length : 4165

SequenceName : SEQ ID NO: 5

SequenceDescription : Barley genomic sequence of cv. Neruda spanning the start and stop codons of the gene encoding LOX-1

Sequence

<213> OrganismName : Hordeum vulgare mutant A618

<400> PreSequenceString :

atgctgctgg gagggctgat cgacaccctc acggggcga acaagagcgc cccggctcaag 60
 ggcacggtgg tgctcatgcg caagaacgtg ctggacctca acgacttcgg cgccaccatc 120
 atcgacggca tcggcgagtt cctcgcaag ggcgtcacct gccagcttat cagctccacc 180
 gccgtcgacc aaggtaatca ctaccctct ccggccttct cctctgttta caagatata 240
 tatttcttc gtgtggccg gcggccatgg atggatggat gtgtctggat cggctaaaga 300
 agataggata gctagccctg gccggtcgtc ttacctgag catggcata tgccatcgaa 360
 aaaagagaca acagcatgca tgcatggtgc gcgcaccaga ccaacgcagag caccggatgc 420
 tcgagacaaa gcaacacaac aagcaaggac gacacgtcaa aagcaacaca acaagcaagg 480
 acggcacgtc aaaagcaaca caaacctaaa ctaaagcaca aagacgtaaag agcaagcaca 540
 caatcagcag gctataaaaca gttgtcatca aaaacaacgc tggaaagagag agagaaggaa 600

ggaagtagta	gccatgaaaa	attaaatcac	cgggcgttgc	totttgcaca	acaattaatc	660
aaggcaggata	cgtggcatgt	atagttcttg	taagtaaact	aagcatgtga	tatgagaagg	720
tacgtggtgg	tgcagacaac	ggcggtcg	ggaaggtggg	cgcggaggcg	gagctggagc	780
agtgggtgac	gagcctg	tcgtgacga	cggggagtc	caagttcggc	ctcaccttc	840
actgggaggt	ggagaagctc	gggggtgc	gcccatacg	cgtcaacaac	taccacagct	900
ccgagttcct	gcttaaaacc	atcacccctcc	acgacgtccc	cggccgcagc	ggcaacctca	960
ccttcgtcgc	caactcatgg	atctaccccg	ccgccaacta	ccgatacagc	cgcgtttct	1020
tcgccaacga	cgtgcgtg	tttcctcta	ctttcctctc	ctttcatttt	caccgccttc	1080
gtcattcatg	gtcgatcatt	aagtcttgc	aggacaatag	atgatgagct	aggagtgg	1140
accacttagc	agtacgtaca	ttatatttc	cgtgtggta	gaaaaggata	tggtttgg	1200
cagatcgaca	caagattgaa	tgaaagttgc	accgtggcac	cgtggcagcg	tggtaggtga	1260
aaataactgt	tgcacggatc	cacccacatg	attgtttca	tgaataaaact	tttaaggat	1320
gtgtctagcc	acatctagat	gcatgtcaca	taattattgc	atacaaaaac	gattaaatta	1380
agcataaaaa	gaaaaggaaa	aaaataactca	catactcga	cgtaaagatca	atgataatgt	1440
atttagat	gcaatattt	tcttacatct	aaaccttct	tcattcctaa	atataagaca	1500
tttctaagat	ttcactatgg	acaacatacg	aaacaaaatc	agtggatctc	tctatgcatt	1560
cattatgtag	tctataataa	aatcttaaa	agatcgata	tttgcaacg	gaggagtaa	1620
aacataactt	tttaatagta	atgttgcacg	gtccacact	cgcagacgta	cctgccgagc	1680
cagatgccgg	cggcgctgaa	gccgtaccgc	gacgacgagc	tccggAACCT	gcgtggcgac	1740
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accacccccc	gcgagttcga	ctccttccag	gacatcatca	acctctatga	ggcgccatc	2100
aagctgccc	aggtgccgc	cctggaggag	ctccgtaagc	agttcccgt	ccagctcatc	2160
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gttcatg	ttcctgatc	acgtcaacaa	cctgcccggc	aacttcatct	acgcac	2760
gaccctt	ttcctgc	gcgacggc	gtc	ccatcg	agctgag	2820
gccc	catc	caggcgg	ttaccacgg	caagagca	gttacac	2880
cggtcc	cg	gaaggct	tgtgg	cgccaaagg	tacgtcg	2940

cgggtggcac cagctcgta	gccactggta cgttctccac	ggtcgatgtg attcagtc	3000
tcgatgcaca acaactgatc	gaaatatgat tgattgaaac	gcgcaggctg aacactca	3060
cggtgatgga gccgttcgtg	atctcgacga accggcacct	tagcgtgacg caccgg	3120
acaagctgct gagccgcac	taccgcgaca ccatgaccat	caacgcgctg gcgcggca	3180
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cgtgctgcag ggcgatacgg	aggtgcaggc gtggtggaaag	gagacgcgcg aggtcgggca	3600
cggcgaccc aaggacgccc	catggtgccca aagatgcaa	agtgtgcgg agctggccaa	3660
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gcccggcacg gaggagtagc	cggagctgga gcgcgacccg	gagcgggcct tcataccac	3840
catcacgagc cagatccaga	ccatcatcggtgt	ctggaggtgc tgtcgaagca	3900
ctcctccgac gagctgtacc	tcgggcagcg ggacacgccc	gagtggacct cggacccaaa	3960
ggccctggag gtgttcaagc	ggttcagcga cccgctggtg	gagatcgaga gcaagtggt	4020
ggcataac catgacccgg	agctcaagaa ccgcaacggc	ccggctaagt ttccctacat	4080
gctgctctac cccaacacct	ccgaccacaa gggcgccgct	gccgggctta ccgccaagggg	4140
catccccaaac agcatctcca	tctaa		4165

<212> Type : DNA

<211> Length : 4165

SequenceName : SEQ ID NO: 6

SequenceDescription : Barley genomic sequence of mutant A618,
 spanning the segment corresponding to the region between
 the start and stop codons of the gene encoding LOX-1 of cv. Neruda

Sequence

<213> OrganismName : Hordeum vulgare cv. Neruda

<400> PreSequenceString :

MLLGGGLIDTL TGANKSARLK	GTVVLMRKNV LDLNDFGATI	IDGIGEFLGK GVTCQLISST	60
AVDQDNNGRG KVGAEEAELEQ	WVTSPLSLTT GESKFGLT	FD WEVEKLGVPD AIVVNHYHSS	120
EFLLKTITLH DVPGRSGNLT	FVANSWIYPA ANYRYSRVFF	ANDTYLPSQM PAALKPYRDD	180
ELRNLRGDDQ QGPYQEHDRI	YRYDVYNDLG EGRPILGGNS	DHPYPRRGRT ERKPNASIDPS	240
LESRLSLLEQ IYVPRDEKFG	HLKTSDLGY SIKAITQGIL	PAVRTYVDTT PGEFDSFQDI	300
INLYEGGIKL PKVAALEELR	KQFPLQLIKD LLPVGGDSLL	KLPVPHIIQE NKQAWRTDEE	360
FAREVLAGVN PVMITRLTEF	PPKSSLDP SK FGDHTSTITA	EHIEKNLEGL TVQQALESNR	420

LYILDHHDRF MPFLIDVNLL PGNFIYATRT LFFLRGDGRL TPLAIELSEP IIQGGLTAK 480
 SKVYTPVPSG SVEGVWELA KAYVAVNDSG WHQLVSHWLN THAVMEPFVI STNRHLSVTH 540
 PVHKLLSPHY RDTMTINALA RQTLINAGGI FEMTVFPGKF ALGMSAVVYK DWKFTEQGLP 600
 DDLIKRGMAV EDPSSPYKVR LLVSDYPYAA DGLAIWHAIE QYVSEYLAIY YPNDGVLQGD 660
 TEVQAWWKET REVGHGDLKD APWWPKMQSV PELAKACTTI IWIGSALHAA VNFGQYPYAG 720
 FLPNRPTVSR RRMPEPGTEE YAELELRDPER AFIHTITSQI QTIIGVSLLE VLSKHSSDEL 780
 YLGQRDTPEW TSDPKALEVF KRFSDRLVEI ESKVVGMNHD PELKNRNGPA KFPYMLLYPN 840
 TSDHKGAAAG LTAKGIPNSI SI 862

<212> Type : PRT

<211> Length : 862

SequenceName : SEQ ID NO: 7

SequenceDescription : Protein sequence of full-length
LOX-1 protein of cv. Neruda

Sequence

<213> OrganismName : Hordeum vulgare mutant A618

<400> PreSequenceString :

MLLGGGLIDTL TGANKSARLK GTVVLMRKNV LDLNDFGATI IDGIGEFLGK GVTCQLISST 60
 AVDQDNGGRG KVGAEAELEQ WVTSLPSLTT GESKFGLTG WEVEKLGVPG AIVVNNYHSS 120
 EFLLKTITLH DVPGRSGNLT FVANSWIYPA ANYRYSRVFF ANDTYLPSQM PAALKPYRDD 180
 ELRNLRGDDQ QGPYQEHDRI YRYDVYNDLG EGRPILGGNS DHPYPRRGRT ERKPNASDPS 240
 LESRLSLLSQ IYVPRDEKFG HLKTSDLFLGY SIKAITQGIL PAVRTYVDTT PGEFDSFQDI 300
 INLYEGGIKL PKVAALEELR KQFPLQLIKD LLPVGGDSLL KLPVPHIIQE NKQAWRTDEE 360
 FAREVLAGVN PVMITRLTMS QRLFVHCVCM VSMVRKCRS 399

<212> Type : PRT

<211> Length : 399

SequenceName : SEQ ID NO: 8

SequenceDescription : Protein sequence of inactive,
truncated LOX-1 of mutant A618

Sequence

<213> OrganismName : Oligonucleotide

<400> PreSequenceString :

gaaagcgagg agaggaggcc aagaacaa

28

<212> Type : DNA

<211> Length : 28

SequenceName : SEQ ID NO: 9

SequenceDescription : Oligonucleotide primer used for PCR amplification (sense primer)

Sequence

<213> OrganismName : Oligonucleotide

<400> PreSequenceString :

ttattcatcc atggttgccg atggcttaga

30

<212> Type : DNA

<211> Length : 30

SequenceName : SEQ ID NO: 10

SequenceDescription : Oligonucleotide primer used for PCR amplification (antisense primer)

Sequence

<213> OrganismName : Oligonucleotide

<400> PreSequenceString :

agggactgcc ggacgatctc a

21

<212> Type : DNA

<211> Length : 21

SequenceName : SEQ ID NO: 11

SequenceDescription : Oligonucleotide primer used for PCR amplification (sense primer)

Sequence

<213> OrganismName : Oligonucleotide

<400> PreSequenceString :

gccagctccg gcacactt

18

<212> Type : DNA

<211> Length : 18

SequenceName : SEQ ID NO: 12

SequenceDescription : Oligonucleotide primer used for PCR amplification (antisense primer)

Sequence

<213> OrganismName : Oligonucleotide

<400> PreSequenceString :
caagggtgcgg ttgctggtgt c
<212> Type : DNA
<211> Length : 21
 SequenceName : SEQ ID NO: 13
 SequenceDescription : Oligonucleotide primer used for PCR
amplification (sense primer)

21

Sequence

<213> OrganismName : Oligonucleotide
<400> PreSequenceString :
ctcgcgcgtc tccttccac
<212> Type : DNA
<211> Length : 19
 SequenceName : SEQ ID NO: 14
 SequenceDescription : Oligonucleotide primer used for PCR
amplification (antisense primer) Sequence

19

<213> OrganismName : Oligonucleotide
<400> PreSequenceString :
ctcgcgcgtc tccttccat
<212> Type : DNA
<211> Length : 19
 SequenceName : SEQ ID NO: 15
 SequenceDescription : Oligonucleotide primer used for PCR
amplification (antisense primer)

19

Sequence

<213> OrganismName : Oligonucleotide
<400> PreSequenceString :
tacgtgccgc gggacgagaa g
<212> Type : DNA
<211> Length : 21
 SequenceName : SEQ ID NO: 16
 SequenceDescription : Oligonucleotide primer used for PCR
amplification (sense primer)

21

Sequence

<213> OrganismName : Oligonucleotide
<400> PreSequenceString :
tgatcatgac cgggttgacg t
<212> Type : DNA
<211> Length : 21
SequenceName : SEQ ID NO: 17
SequenceDescription : Oligonucleotide primer used for PCR
amplification (antisense primer)

21

Sequence

<213> OrganismName : Oligonucleotide
<400> PreSequenceString :
catatgctgc tgggagggct g
<212> Type : DNA
<211> Length : 21
SequenceName : SEQ ID NO: 18
SequenceDescription : Oligonucleotide primer used for PCR
amplification (sense primer)

21

Sequence

<213> OrganismName : Oligonucleotide
<400> PreSequenceString :
gaattcttag atggagatgc tgttggg
<212> Type : DNA
<211> Length : 27
SequenceName : SEQ ID NO: 19
SequenceDescription : Oligonucleotide primer used for PCR
amplification (antisense primer)

27

Sequence

<213> OrganismName : Oligonucleotide
<400> PreSequenceString :
ctaccgtac gcggcggacg ggct
<212> Type : DNA

24

<211> Length : 24
SequenceName : SEQ ID NO: 20
SequenceDescription : Oligonucleotide primer used for PCR
amplification (sense primer)

Sequence

<213> OrganismName : Oligonucleotide

<400> PreSequenceString :

tcctgaattc acgcctgcac ctccgtatcg c

31

<212> Type : DNA

<211> Length : 31

SequenceName : SEQ ID NO: 21

SequenceDescription : Oligonucleotide primer used for PCR
amplification (antisense primer)